INL researchers outfitted a Talon robot with a Robotic Intelligence Kernel, a technology that allows it to interpret and "understand" its surroundings so it could navigate a smuggler's tunnel along the U.S./Mexico border.

Using smart robots to navigate smugglers' tunnels

by Kortny Rolston, *INL Communications & Public Affairs*

Robots have pinpointed land mines on the ground and imaged fields from the air. Now, robots equipped with Idaho National Laboratory's lauded Robotic Intelligence Kernel (RIK) are exploring new terrain or, more accurately, subterrain.

INL robotic researcher Victor Walker shows Border Patrol agents and others at the demonstration what kind of data RIK-equipped robots can gather in the field.

Twice in recent months, INL researchers have demonstrated their robots can interrogate and map underground tunnels, including a smuggler's route 50 feet below the U.S./Mexico border.

The tunnel runs were major feats for the RIK, a technology that allows a robot to interpret and "understand" its surroundings so it can operate autonomously in the field.

"Tunnels tend to be tough environments for robots because you usually can't use a cable as a tether and you often lose communications so it's hard to control them remotely," said David Bruemmer, INL's lead adaptive robotics researcher. Bruemmer oversaw the first test in October at the Pisgah Astronomical Research Institute in North Carolina.

Bruemmer and the team outfitted an iRobot "Packbot" robot with the RIK and ran it through a 600-meter-long tunnel that stretched from one of the campus's large radio telescopes to the other. The team developed some new behaviors for the robot so it could better navigate the special characteristics of tunnels.

The robot was able to map the entire length even though it lost communication with Bruemmer and had to map and handle the hazards independently. As soon it regained contact, it transmitted what it had recorded so the team could quickly view relevant data about the entire tunnel.

"It was really a "put up" or "shut up" test for us to see what our robots could do," Bruemmer said. Army officials shared the results with U.S. Customs and Border Protection managers who requested a second demonstration in a seized smuggler's tunnel located in southeast Arizona.

Tunnel troubles

In 2006, Congress passed the Secure Border Fence Act to try to stanch the flow of illegal immigrants and drugs across the U.S./Mexico border. The law authorized the construction of a double-reinforced fence that, once complete, will span more than 700 miles across California, Arizona, New Mexico and Texas.

The robot traversed the smuggler's tunnel and

The push to fence off the country's southern border has forced the Mexican drug trade underground. Cartels have since created miles of underground tunnels to maintain their lucrative drug trade in the United States. (Since the law was passed, Arizona border agents have discovered more than 30 new tunnels, the most ever found in the state.)

And that has created an acute need for technologies like above-ground sensors that detect digging and robots that can investigate unknown tunnels, which can be dangerous to agents.

"The cartels have a lot invested in those tunnels so there is a possibility they may be booby-trapped," said Victor Walker, an INL robotic researcher. "(Border Patrol) doesn't want to send humans into them until they know what the environment is like."

The tunnel test

Walker traveled to Arizona in December to man the second tunnel test.

He was prepared for a dirt tunnel with a simple opening, maybe a door or an obvious hatch like you would see in a movie.

recorded data despite the muddy, wet conditions. Once they discovered the tunnel, Border Patrol agents seized it and flooded it with water.

Instead, Border Patrol agents escorted him to a drain in the back of a small warehouse. Two levels and 50 feet below was a narrow tunnel with concrete walls, arched ceilings and a pulley system that was used to raise and lower the drugs and contraband.

Agents discovered it in the 1990s and eventually flooded it with water, which left more than a foot and a half of mud and water in the middle of the tunnel.

"It surprised me," Walker said. "I really didn't think it would be so deep underground or difficult to get into."

He and a team from Foster-Miller used ropes and the pulley system to lower a RIK-equipped Talon robot into the muddy tunnel. From the warehouse above, they monitored and controlled the robot as long as it could maintain communications. The robot was able to record various data — including a map of the tunnel and various gas and chemical levels — and report back to the agents on the surface.

"The robot did really well, especially considering the adverse conditions," Walker said. "It was pretty wet and narrow down there. The robot didn't have room to turn around or much area to maneuver in, and it was easy for the tracks to slip."

After running the tunnels, Walker and Bruemmer are convinced RIK-equipped robots could be a key tool for the Border Patrol and the military, which regularly contends with hazardous tunnels in Iraq and other areas of conflict.

"We proved our robots were able to operate in a tunnel environment," Bruemmer said. "We were able to show some real-world work that hadn't been done before."

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